

Original article

Comparative Study Between Laparoscopic Tubal Disconnection, Ultrasound-Guided Tubal Aspiration and Hysteroscopic Tubal Occlusion in the Management of Hydrosalpinx Prior to ICSI

Murad Eljall¹ , Rania Gammo² , Laila Debri^{*3} ¹Department of Gynecology and Obstetrics, Faculty of Medicine, University of Gharyan, Libya²Department of Gynecology and Obstetrics, University of Zawiyah, Libya.³Department of Obstetrics and Gynecology, Faculty of Medicine, University of Tripoli, LibyaEmail. L.debri@uot.edu.ly**Keywords:**

Hydrosalpinx, ICSI, Tubal Disconnection, Hysteroscopic Occlusion, Ultrasound-Guided Aspiration, Infertility.

ABSTRACT

To compare the efficacy of laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, and ultrasound-guided aspiration in the management of hydrosalpinx prior to intracytoplasmic sperm injection (ICSI). Sixty women with unilateral or bilateral hydrosalpinx undergoing ICSI were randomly allocated into three equal groups. Participants underwent laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, or ultrasound-guided aspiration of hydrosalpinx fluid. The primary outcome was the clinical pregnancy rate, while the secondary outcome was the chemical pregnancy rate. Baseline demographic characteristics, hormonal profile, ovarian response, endometrial thickness, oocyte yield, and embryo quality were comparable among the three groups. Clinical pregnancy rates were 50.0% (10/20), 50.0% (10/20), and 40.0% (8/20) in the laparoscopic disconnection, hysteroscopic occlusion, and aspiration groups, respectively ($p = 0.765$). Chemical pregnancy rates were 55.0% (11/20), 50.0% (10/20), and 40.0% (8/20), respectively ($p = 0.627$). No statistically significant differences were observed among the three treatment groups regarding ovarian response, embryological outcomes, or pregnancy rates. Laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, and ultrasound-guided aspiration demonstrated comparable reproductive outcomes in women with hydrosalpinx undergoing ICSI. All three approaches may be considered effective treatment options before assisted reproductive treatment.

Introduction

Tubal factor infertility is responsible for approximately one-quarter to one-third of female infertility cases and remains a major indication for assisted reproductive technology (ART) [1]. Among tubal pathologies, hydrosalpinx represents the most advanced form of distal tubal disease and is characterized by the accumulation of serous fluid within an obstructed fallopian tube. Hydrosalpinx is detected in approximately 10–30% of women undergoing in vitro fertilization (IVF) and has consistently been associated with lower implantation, clinical pregnancy, and live birth rates, together with a higher risk of miscarriage and ectopic pregnancy [2–4]. The mechanisms by which hydrosalpinx negatively affects reproductive outcomes are multifactorial. Reflux of hydrosalpingeal fluid into the uterine cavity may mechanically interfere with embryo implantation, while inflammatory mediators and embryotoxic substances contained within the fluid may impair embryo development. Furthermore, hydrosalpinx has been shown to reduce endometrial receptivity by altering the expression of implantation-associated molecules, including HOXA10, integrins, and leukemia inhibitory factor [2,5].

Current evidence supports surgical management of communicating hydrosalpinges before IVF. The American Society for Reproductive Medicine (ASRM) recommends laparoscopic salpingectomy as the preferred treatment for surgically accessible hydrosalpinges, whereas proximal tubal occlusion is considered an acceptable alternative when salpingectomy is technically difficult or contraindicated [1]. Randomized controlled trials and subsequent systematic reviews have demonstrated that interruption of communication between the hydrosalpinx and the uterine cavity significantly improves implantation and pregnancy outcomes following IVF [3,6].

Despite these recommendations, laparoscopic surgery may not be appropriate for all patients because of severe pelvic adhesions, previous pelvic surgery, extensive endometriosis, or medical contraindications. Consequently, less invasive alternatives, including hysteroscopic tubal occlusion and ultrasound-guided aspiration of hydrosalpingeal fluid, have been investigated. These techniques aim to eliminate the adverse effects of hydrosalpingeal fluid while avoiding the morbidity associated with laparoscopic surgery. However, available evidence comparing these approaches remains limited, and their

relative effectiveness continues to be debated [7–9]. Given the limited comparative evidence regarding minimally invasive treatment strategies, further clinical studies are needed to determine whether these approaches provide reproductive outcomes comparable to conventional surgical management.

The aim of this study was to compare the efficacy of laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, and ultrasound-guided aspiration in women with hydrosalpinx undergoing intracytoplasmic sperm injection (ICSI), and to evaluate their effects on reproductive outcomes.

Patients and Methods

Study Design and Participants

This clinical trial was conducted at the Department of Obstetrics and Gynecology, Dar Al-Teb Clinic, Gharyan Hospital, Gharyan University. The study included 60 women with tubal factor infertility due to unilateral or bilateral hydrosalpinx who were scheduled for ICSI treatment.

Inclusion Criteria

Women aged 20–30 years with primary or secondary infertility, unilateral or bilateral hydrosalpinx diagnosed by imaging studies, and scheduled for ICSI using the long agonist stimulation protocol were eligible for inclusion.

Exclusion Criteria

Women with male factor infertility, uterine factor infertility, poor ovarian reserve, poor ovarian response, body mass index greater than 30 kg/m², or significant medical disorders were excluded.

Clinical Assessment

All participants underwent detailed clinical evaluation, gynecological examination, transvaginal ultrasonography, and hysterosalpingography (HSG). Hysterosalpingography performed within six months before enrollment demonstrated unilateral or bilateral hydrosalpinx characterized by dilated fallopian tubes with loss of normal mucosal folds and absent or reduced peritoneal spill. Diagnostic hysteroscopy was performed to evaluate the uterine cavity and exclude intrauterine pathology. Diagnostic laparoscopy was used when indicated to assess pelvic anatomy, detect endometriosis, evaluate tubal status, and perform the planned surgical intervention.

ICSI Protocol

All patients underwent controlled ovarian hyperstimulation using a long luteal phase GnRH agonist protocol. Decapeptyl 0.1 mg was administered subcutaneously daily starting on day 21 of the preceding cycle. Following confirmation of pituitary downregulation (serum estradiol < 50 pg/mL), ovarian stimulation was initiated using 225–300 IU of human menopausal gonadotropin (hMG) daily. Dosage adjustments were made according to ovarian response monitored by ultrasonography. Ovulation was triggered using 10,000 IU of human chorionic gonadotropin (hCG) when at least two follicles reached a mean diameter of 18 mm. Oocyte retrieval was performed 34–36 hours after hCG administration under transvaginal ultrasound guidance. Embryo transfer was performed on days 3–5 after oocyte retrieval. Chemical pregnancy was confirmed by serum β -hCG measurement two weeks after embryo transfer, while clinical pregnancy was confirmed by transvaginal ultrasonography demonstrating fetal cardiac activity five weeks after embryo transfer.

Study Outcomes

The primary outcome measure was the clinical pregnancy rate following treatment of hydrosalpinx prior to ICSI. The secondary outcome measure was the chemical pregnancy rate. Baseline comparability between groups was assessed using the number of retrieved oocytes, oocyte maturity, endometrial thickness on the day of hCG administration, and the number and quality of transferred embryos.

Randomization and Study Groups

Participants were randomly assigned to one of three equal groups (n = 20 each):

Group LD

Patients underwent laparoscopic proximal tubal disconnection one month before the ICSI cycle.

Group HO

Patients underwent hysteroscopic tubal occlusion using bipolar electrosurgical coagulation of the tubal ostia one month before the ICSI cycle.

Group AS

Patients underwent transvaginal ultrasound-guided aspiration of hydrosalpinx fluid at the time of oocyte retrieval.

Surgical Techniques

Laparoscopic Tubal Disconnection (LD Group)

Under general anesthesia, laparoscopic proximal tubal disconnection was performed using bipolar diathermy applied approximately 2–3 cm from the uterine cornu, followed by transection of the coagulated segment.

Hysteroscopic Tubal Occlusion (HO Group)

Under general anesthesia, hysteroscopic evaluation of the uterine cavity was performed, followed by bipolar coagulation of both tubal ostia.

Ultrasound-Guided Aspiration (AS Group)

Hydrosalpinx fluid was aspirated transvaginally under ultrasound guidance immediately after oocyte retrieval using the aspiration needle.

Ethical Considerations

The study protocol was approved by the local institutional ethics committee. Written informed consent was obtained from all participants prior to enrollment.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were expressed as mean $\pm$ standard deviation or median (range), as appropriate. Qualitative variables were expressed as frequency and percentage. Comparisons between groups were performed using one-way analysis of variance (ANOVA) or the Kruskal–Wallis test for quantitative variables, and the Chi-square test for categorical variables. All statistical tests were two-tailed, and a p-value < 0.05 was considered statistically significant.

Results

A total of 60 women with hydrosalpinx undergoing ICSI were included and equally allocated into three groups according to the treatment modality. Group LD underwent laparoscopic proximal tubal disconnection, Group HO underwent hysteroscopic tubal occlusion, and Group AS underwent ultrasound-guided aspiration of hydrosalpinx fluid.

Baseline Characteristics

The three groups were comparable regarding age and body mass index (BMI) (Table 1). Similarly, no statistically significant differences were observed in the pretreatment hormonal profile, including follicle-stimulating hormone (FSH), luteinizing hormone (LH), prolactin, estradiol (E2), anti-Müllerian hormone (AMH), or antral follicle count (AFC) (Table 2, Figure 1).

Table 1. Age and body mass index of the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Age (years)	25.4 $\pm$ 2.9	24.7 $\pm$ 3.6	24.8 $\pm$ 2.8	0.633
Body mass index (kg/m ²)	22.4 $\pm$ 2.6	22.5 $\pm$ 2.5	21.8 $\pm$ 2.1	0.797

Data presented as mean $\pm$ SD

Table 2. Hormonal profile and antral follicle count of the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
FSH (IU/mL)	4.7 $\pm$ 1.2	5.0 $\pm$ 1.1	4.3 $\pm$ 1.2	0.424
LH (IU/mL)	3.8 $\pm$ 1.0	4.0 $\pm$ 0.9	3.4 $\pm$ 0.9	0.607
Prolactin (ng/mL)	16.3 $\pm$ 4.5	15.6 $\pm$ 4.2	15.9 $\pm$ 4.1	0.617
Estradiol (pg/mL)	38.4 $\pm$ 15.2	38.1 $\pm$ 13.7	39.2 $\pm$ 12.7	0.946
AMH (ng/mL)	4.6 $\pm$ 1.5	4.5 $\pm$ 1.3	4.5 $\pm$ 1.6	0.903
Antral follicle count (AFC)	14 (8-17)	12 (7-16)	12 (7-17)	0.065

Data presented as mean $\pm$ SD or median (range)

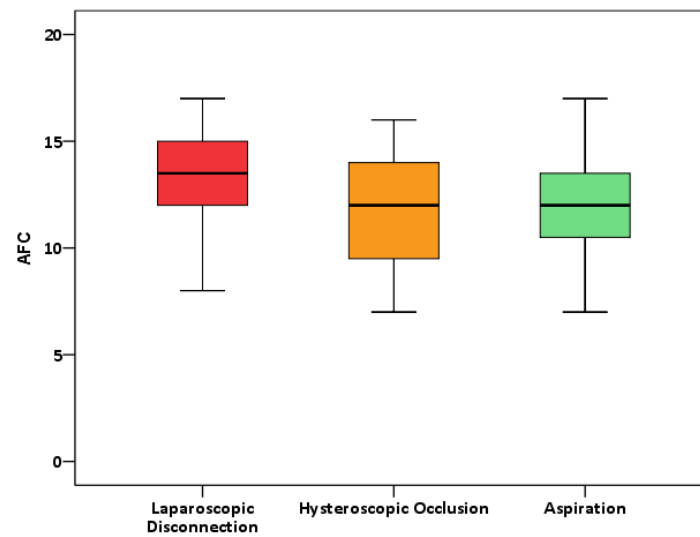


Figure 1. Antral Follicle Count (AFC) in the three studied groups

All participants underwent controlled ovarian hyperstimulation using human menopausal gonadotropin (hMG). The total hMG dose was comparable among the three groups, with no statistically significant difference observed ($p = 0.989$) (Table 3).

Table 3. Total dose of hMG used in the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Total hMG dose (IU)				0.989
Mean±SD	3086±411	3079±472	3038±453	
Median (Range)	3000 (2250-3600)	3300 (2250-3600)	3150 (2250-3600)	

Likewise, serum estradiol levels and endometrial thickness measured on the day of hCG administration did not differ significantly between groups ($p = 0.409$ and $p = 0.329$, respectively) (Table 4).

Table 4. Estradiol level on the day of hCG injection and endometrial thickness in the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Estradiol level (pg/mL)				0.409
Mean±SD	2860±323	2759±431	2992±295	
Median (Range)	2861 (2174-3406)	2811 (2016-3511)	2976 (2486-3510)	
Endometrial Thickness (mm)				0.329
Mean±SD	10.2±1.5	10.7±1.8	10.5±1.6	
Median (Range)	10.0 (8.0-13.0)	10.5 (8.0-13.0)	10.5 (8.0-13.0)	

Oocyte Retrieval and Embryological Outcomes

The total number of retrieved oocytes was comparable among the three groups ($p = 0.403$). No statistically significant differences were observed in the number of atretic oocytes, germinal vesicle (GV) oocytes, metaphase I (MI) oocytes, or metaphase II (MII) oocytes (Table 5, Figure 2).

Table 5. Total number and phase of retrieved ova in the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Total No Ova Retrieved	13 (9-16)	12 (8-16)	13 (10-16)	0.403
No. of Atretic ova	0 (0-2)	0 (0-2)	0 (0-2)	0.724
No. of GV oocytes	0 (0-4)	0 (0-3)	1 (0-3)	0.947
No. of MI oocytes	4 (3-7)	5 (3-7)	5 (3-7)	0.878
No. of MII oocytes	6 (5-10)	7 (4-10)	7 (4-11)	0.407

GV: germinal vesicle phase, MI: metaphase I, MII: metaphase II

Similarly, embryological outcomes were comparable between groups. No significant differences were detected in the total number of embryos obtained or in embryo grading (Table 6). Grade A embryos represented the majority of embryos in all groups.

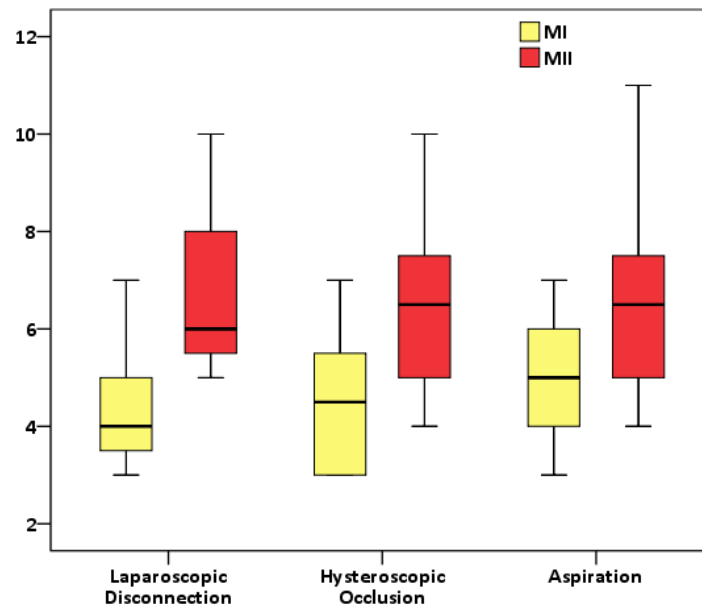


Figure 2. The number of MI and MII oocytes retrieved in the three studied groups

Table 6. Total number and grade of produced embryos in the three studied group

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Total No of embryos	7 (4-10)	7 (5-10)	8 (5-11)	0.666
Grade A	6 (3-9)	5 (3-7)	6 (4-8)	0.256
Grade B	1 (0-3)	1 (0-3)	1 (0-3)	0.060
Grade C	1 (0-3)	0 (0-2)	1 (0-3)	0.312

Data presented as median (range)

Table 7. Proportion of clinical and chemical pregnancies in the three studied groups

	Group LD n=20	Group HO n=20	Group AS n=20	p value
Clinical Pregnancy				0.765
Positive	10 (50.0%)	10 (50.0%)	8 (40.0%)	
Negative	10 (50.0%)	10 (50.0%)	12 (60.0%)	
Chemical Pregnancy				0.627
Positive	11 (55.0%)	10 (50.0%)	8 (40.0%)	
Negative	9 (45.0%)	10 (50.0%)	12 (60.0%)	

Figure 3 show no statistically significant differences were observed among the three treatment groups regarding clinical pregnancy rates ($p = 0.765$) or chemical pregnancy rates ($p = 0.627$). Clinical pregnancy was achieved in 50.0% of patients in both the laparoscopic disconnection and hysteroscopic occlusion groups, compared with 40.0% in the aspiration group. Chemical pregnancy was recorded in 55.0%, 50.0%, and 40.0% of patients in Groups LD, HO, and AS, respectively. One biochemical pregnancy in the laparoscopic disconnection group did not progress to clinical pregnancy. Overall, the three treatment modalities demonstrated comparable reproductive outcomes, with no statistically significant differences in ovarian response, embryological parameters, or pregnancy rates.

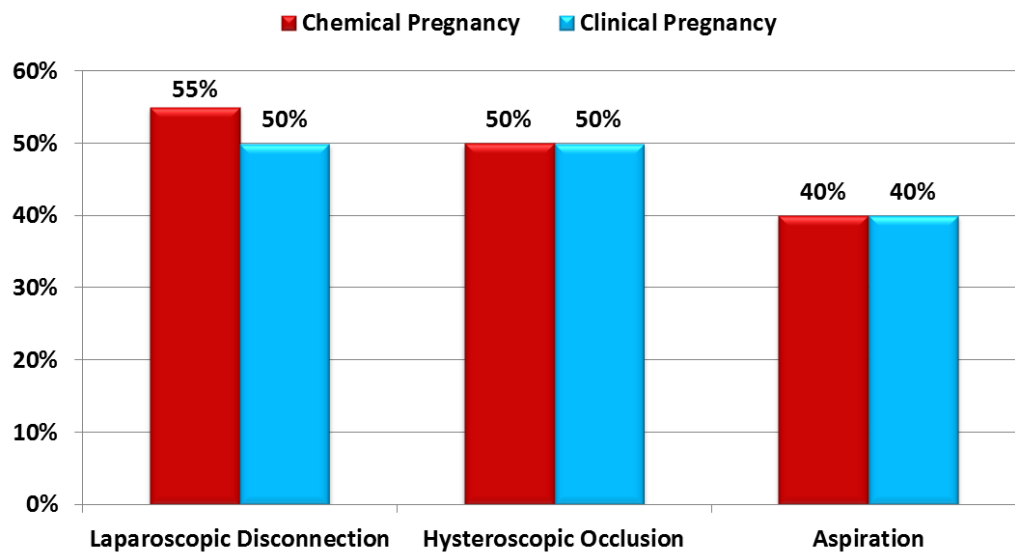


Figure 3. Proportion of clinical and chemical pregnancies in the three studied groups

Discussion

Hydrosalpinx remains one of the most important reversible causes of implantation failure in women undergoing assisted reproductive technology. Numerous studies have demonstrated that untreated hydrosalpinx significantly reduces implantation, clinical pregnancy, ongoing pregnancy, and live birth rates while increasing the risk of pregnancy loss. Consequently, current international guidelines recommend treatment of communicating hydrosalpinges before IVF or ICSI whenever technically feasible [1]. The present study compared three treatment strategies for hydrosalpinx before ICSI: laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, and ultrasound-guided aspiration. Baseline demographic characteristics, ovarian reserve markers, ovarian response to controlled ovarian stimulation, endometrial thickness, oocyte maturity, and embryo quality were comparable among the three groups, indicating successful randomization and minimizing the likelihood that baseline differences influenced reproductive outcomes. The principal finding of the present study was the absence of statistically significant differences in either chemical or clinical pregnancy rates among the three treatment modalities.

Clinical pregnancy was achieved in 50% of women undergoing laparoscopic proximal tubal disconnection, 50% following hysteroscopic tubal occlusion, and 40% after ultrasound-guided aspiration. Although pregnancy rates were numerically lower in the aspiration group, the difference did not reach statistical significance, suggesting that all three approaches may provide comparable reproductive outcomes in appropriately selected patients. These findings support the concept that interruption of communication between the hydrosalpinx and the uterine cavity may be more important than the specific treatment technique itself. The detrimental effect of hydrosalpinx is believed to result primarily from continuous reflux of hydrosalpingeal fluid into the uterine cavity, leading to impaired endometrial receptivity, altered implantation, and mechanical embryo washout rather than impaired ovarian function [2,5]. Our findings are consistent with the prospective randomized multicentre trial by Strandell et al., which demonstrated improved IVF outcomes following surgical management of hydrosalpinx before assisted reproduction [3].

Likewise, the Cochrane systematic review by Johnson et al. confirmed that surgical treatment before IVF significantly improves clinical pregnancy and ongoing pregnancy rates compared with no intervention, supporting the current recommendation for pre-IVF management of communicating hydrosalpinges [6]. The comparable pregnancy outcomes observed between laparoscopic proximal tubal disconnection and hysteroscopic tubal occlusion are also consistent with the findings of Kontoravdis et al., who reported similar implantation and clinical pregnancy rates following proximal tubal occlusion and salpingectomy, suggesting that proximal tubal occlusion may represent an effective alternative when salpingectomy is technically difficult or contraindicated [10].

Ultrasound-guided aspiration also produced pregnancy outcomes that were not statistically different from those achieved with the surgical approaches, although numerically lower pregnancy rates were observed in the aspiration group. This finding should be interpreted cautiously because the present study was not powered to detect relatively small differences in pregnancy outcomes. Hammadih et al. demonstrated that aspiration of hydrosalpingeal fluid performed immediately after oocyte retrieval significantly improved IVF outcomes compared with no intervention, suggesting that temporary elimination of hydrosalpingeal fluid may improve endometrial receptivity during the implantation window [7]. Similar findings were reported by Fouda and Sayed, who observed improved reproductive outcomes after aspiration in selected women with ultrasound-visible hydrosalpinx, although they also highlighted the possibility of rapid re-accumulation of

hydrosalpingeal fluid, which may reduce the long-term effectiveness of this approach [8]. Current evidence nevertheless indicates that salpingectomy and proximal tubal occlusion remain the treatment strategies supported by the strongest clinical evidence before IVF, whereas evidence supporting ultrasound-guided aspiration remains relatively limited because of the small number of randomized controlled trials and the potential recurrence of hydrosalpingeal fluid [6]. Therefore, aspiration may be considered a reasonable alternative in carefully selected patients who are poor candidates for laparoscopic surgery because of severe pelvic adhesions, previous pelvic surgery, or significant anesthetic or surgical risk. Another important observation in the present study was the absence of significant differences among the three groups regarding ovarian response to stimulation, total gonadotropin dose, number of retrieved oocytes, oocyte maturity, embryo quality, or endometrial thickness. These findings suggest that treatment of hydrosalpinx primarily improves the uterine environment rather than ovarian function, which is consistent with previous experimental and clinical studies demonstrating that hydrosalpingeal fluid mainly impairs implantation through alterations in endometrial receptivity and the intrauterine environment rather than ovarian reserve [2,5].

The strengths of the present study include its prospective randomized design, comparable baseline characteristics among the treatment groups, standardized ovarian stimulation protocol, and uniform embryological assessment, all of which enhance the internal validity of the findings. However, several limitations should be acknowledged. The relatively small sample size may have limited the statistical power to detect modest differences in pregnancy outcomes among the treatment modalities. Furthermore, this was a single-center study, and follow-up was limited to clinical pregnancy without assessment of live birth rates. Future multicenter randomized controlled trials with larger sample sizes and live birth as the primary outcome are warranted to further define the optimal management strategy for women with hydrosalpinx undergoing assisted reproductive treatment.

Study Limitations

This study was limited by its relatively small sample size and single-center design. In addition, follow-up was restricted to chemical and clinical pregnancy outcomes, while live birth rates were not evaluated. Further large-scale multicenter studies are warranted to validate these findings and better define the optimal management strategy for hydrosalpinx before ICSI.

Conclusion

The present study demonstrated comparable clinical and chemical pregnancy rates following laparoscopic proximal tubal disconnection, hysteroscopic tubal occlusion, and ultrasound-guided aspiration in women with hydrosalpinx undergoing ICSI. All three approaches may be considered effective treatment options. Selection of the appropriate intervention should be individualized according to patient characteristics, surgical feasibility, and clinical circumstances.

Funding

This study received no financial support from public, commercial, or non-profit funding agencies.

Competing interests

The authors have nothing to declare.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

References

1. Practice Committee of the American Society for Reproductive Medicine. Role of tubal surgery in the era of assisted reproductive technology: a committee opinion. *Fertil Steril*. 2021;115(5):1143-50.
2. Strandell A. The influence of hydrosalpinx on IVF and embryo transfer. *Hum Reprod Update*. 2000;6(4):387-95.
3. Strandell A, Lindhard A, Waldenström U, Thorburn J, Janson PO, Hamberger L. Hydrosalpinx and IVF outcome: a prospective randomized multicentre trial in Scandinavia on salpingectomy prior to IVF. *Hum Reprod*. 1999;14(11):2762-9.
4. Zeyneloglu HB, Arici A, Olive DL. Adverse effects of hydrosalpinx on pregnancy rates after in vitro fertilization-embryo transfer. *Fertil Steril*. 1998;70(3):492-9.
5. Meyer WR, Castelbaum AJ, Somkuti S, Sagoskin AW, Doyle M, Harris JE, et al. Hydrosalpinges adversely affect markers of endometrial receptivity. *Hum Reprod*. 1997;12(7):1393-8.
6. Johnson N, van Voorst S, Sowter MC, Strandell A, Mol BW. Surgical treatment for tubal disease in women due to undergo in vitro fertilisation. *Cochrane Database Syst Rev*. 2010;(1):CD002125.
7. Hammadih N, Coomarasamy A, Ola B, Papaioannou S, Afnan M, Sharif K. Ultrasound-guided hydrosalpinx aspiration during oocyte collection improves pregnancy outcome in IVF: a randomized controlled trial. *Hum Reprod*. 2008;23(5):1113-7.



8. Fouda UM, Sayed AM. Effect of ultrasound-guided aspiration of hydrosalpingeal fluid during oocyte retrieval on the outcomes of in vitro fertilisation-embryo transfer: a randomized controlled trial. *Gynecol Endocrinol.* 2011;27(8):562-7.
9. Darwish AM, El Saman AM. Is there a role for hysteroscopic tubal occlusion of functionless hydrosalpinges prior to IVF/ICSI? *Acta Obstet Gynecol Scand.* 2007;86(12):1488-93.
10. Kontoravdis A, Makrakis E, Pantos K, Botsis D, Deligeoroglou E, Creatsas G. Proximal tubal occlusion and salpingectomy result in similar improvement in in vitro fertilization outcome in patients with hydrosalpinx. *Fertil Steril.* 2006;86(6):1642-9.